International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-6; Jun, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.96.46

Occurrence and type of complications associated with mandibular bilateral removable partial denture: Prospective cohort data

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Received: 19 May 2022,

Received in revised form: 17 Jun 2022,

Accepted: 24 Jun 2022,

Available online: 30 Jun 2022

Keywords *— **removable partial denture, partially edentulous arch, mandible, complications.***

Abstract— *Purpose. The aim of this study was to assess the occurrence and type of complications with mandibular Kennedy Class I removable partial denture (RPD) over time. Materials and Methods. A total of 65 patients wearing mandibular free-end RPD and maxillary complete denture (CD) treated at the Department of Dentistry of Federal University of Rio Grande do Norte (UFRN) were evaluated. The tests were conducted after 2, 6 and 12 months. Annual follow-up was also accomplished after the 12-month evaluation. Complications or failures were recorded in a specific clinical report over 39 months. The failures were classified as: ulceration after 2 months of denture insertion, loss of retention, fracture or caries in rest seat, fracture or displacement of artificial teeth, fracture of a major connector, fracture of a clasp, fracture of the rest, relining and fracture of the denture. Results. Low complication rate was reported and most of the cases occurred after 2 years of denture insertion. Loss of retention was the most common complication (31.57%). Fracture of the metallic framework components was not a frequent occurrence and only one patient reported a fracture of a major connector (5.3%). Conclusion. The treatment with mandibular free-end RPD showed low failure rates after 39 months of periodical follow-up.*

I. INTRODUCTION

Free-end removable partial dentures (RPDs) have a dual support system (teeth and fibromucosa) with different resilience, anatomical characteristics and transfer of masticatory loads.[1] Therefore, this type of denture is associated with biomechanical problems (retention and stability) that compromise masticatory efficiency.[2] Also, its limited functional and aesthetic properties,[3] as well as its relatively high complication rates[4-6] may explain the discomfort and dissatisfaction reported by patients. [7,8]

For these reasons, some patients rehabilitated with RPD do not regularly wear their dentures, and clinicians need to consider different treatment alternatives, such as dental implants. However, the presence of bone defects at the implantation location or limitation of height and bone thickness limits the installation of conventional implants, which can be circumvented by solutions such as: short implants,[9] preliminary bone reconstruction of the edentulous mandible, through the combination of bone substitutes with autologous mesenchymal stem cells or autologous bone graft[10-12] or bone substitutes of animal, human or synthetic origin used alone,[13] as well as implant-supported removable and fixed partial dentures.[1]

The performance of alternative treatments is associated with high cost, treatment time and even postoperative morbidity. That said, conventional DPR's are an economical and easy treatment modality for partially edentulous patients and are still widely used.[14] Some clinical trials reported the occurrence and type of prosthetic complications for different removable partial denture (PPR) designs.[8,15,16] It was observed that loss of retention, presence of ulcers, increased vertical dimension, inadequate centric relationships,[8] as well as aesthetic and phonetic problems, chewing pain, gag reflex[16] and fracture of artificial teeth and/or prosthesis[15] are the main complications associated with PPR's.

Most of the reported failures are recurrent from the destructive action of poorly designed and manufactured prostheses, considering that most clinicians delegate planning to technicians and, when they do so, commonly disregard the planning principles for tooth-mucosal-supported removable prostheses (REF).[8] For these reasons, when planned according to the biomechanical principles of performance of this type of prostheses, followed by regular follow-up visits to the dentist, they can minimize the complications normally associated with them and demonstrate long-term success. Although some studies[6,15,17,18] have evaluated factors related to treatment success, there is a lack of data on the characteristics that influence the prognosis and the occurrence of complications or technical and mechanical failures in Kennedy Class I RPDs. Therefore, considering the lack of evidence on the prognosis of RPD with tooth-mucosal support, the aim of this study was to assess the occurrence and type of failures and complications with Kennedy Class I mandibular RPD.

II. MATERIALS AND METHODS

Study design

This individualized, observational and longitudinal cohort study was carried out at the Department of Dentistry of the Federal University of Rio Grande do Norte (UFRN), which was approved by the Research Ethics Committee (CEP-UFRN/protocol 60244) and by the Brazilian Registry of Clinical Trials (RBR-8fs5ww protocol), in addition to having followed the recommendations of the 1975 Declaration of Helsinki (revised August 26, 2018). The guidelines of the Report of Observational Studies in Epidemiology (STROBE)[19] were followed to carry out this study.

The sample was calculated using the OpenEpi software using the results of a previous study authored by Bilhan, et al. (2012),[8] which evaluated the frequency and type of prosthetic complications in relation to the type of prosthesis. Fourteen (66.7%) of the patients rehabilitated with a complete upper denture and a lower removable partial denture (n=21) had loss of denture retention. Therefore, 7 (n=21) patients showed no loss of retention of their dentures, that is, 33.3% (not exposed) and 66.7% (exposed). A significance level and a power of 95% (1-beta, % of detection probability) of 80% were considered, totaling 41 patients.

Population

The sample was non-probabilistic and voluntary, composed of 65 patients, with a mean age of 53.9 years, users of upper conventional total dentures and bilateral free extremity lower removable partial dentures, of both genders, with a good health status, or general health rehabilitated in the clinics of the Department of Dentistry at UFRN. In addition, according to the individualized clinical examination for each patient, they should present the ridge in the posterior region of the mandible classified as resorbed.

Patients with any systemic health deficiency were excluded, as well as those who met the inclusion criteria, but did not sign the free and informed consent form, considered essential for inclusion in the study.

Fabrication of removable partial dentures (RPD)

Initially, patients underwent anamnesis (intraoral and extraoral clinical examination) to assess their general health status, history and expectation with treatment, as well as soft tissue conditions, ridge height, type of mucosa, in addition to radiographs, intraoral implants of the abutment teeth for the prosthesis.

Afterwards, a preliminary image of the mandibular arch was performed (Jeltrate, Dentsply, Brazil), followed by the continuation of the study model, whose study was carried out using a parallelometer (Bio-art) regarding the lack of retentive areas and/or absence of retentive areas and guide planes on the abutment teeth of the RPD for, later, the mouth preparation. Then, the

prepared arches were molded again to the working models, and using the parallelometer, it was then sent to the laboratory for the fabrication of the structure.

The metallic structure was tested in the mouth, observing its insertion and removal, and the total seating of the supports on the niches. Then, the impression technique of the altered model was carried out, whose metallic structure was positioned on the working model to obtain an acrylic tray (Dencor, Rio Branco, Brazil) in the region corresponding to the prosthetic space. Afterwards, the tray was adjusted in the mouth, followed by peripheral molding with low-melting compound (Exata, DFL Indústria e Comércio Ltda, Brazil) and body molding with polyether (ImpregumTMSoft, 3M ESPE, Germany) to obtain the functional model. Based on this, the test base and wax plane were made, adjusted in the mouth and then the maxillomandibular registration was performed in the central position and mounted in a semi-adjustable articulator (Bio-art, Brazil). The artificial teeth (Biotone, Dentsply, Brazil) were mounted, followed by the clinical trial and conventional workflow for acrylization of the denture base. After acrylization, the model was reassembled in an articulator for occlusal adjustment of the prosthesis.

At the time of prosthesis installation, stability, retention, possible areas of understanding and occlusion were evaluated. All patients were instructed on hygiene procedures and prosthesis care.[20]

Presence of traumatic ulcers after two months of RPD installation

The integrity of the fibromucosa was evaluated in the periodic control sessions by a single evaluator. After the installation of removable partial dentures, controls were performed at 24 hours, 7, 15, 30 and 60 days, and 6 months, with the aim of identifying the occurrence of whitish traumatic ulcers, with small dimensions and well-defined flat edges with an erythematous halo.[21,22]

Occurrence of prosthetic failures and complications

To assess the occurrence of complications related to the lower removable partial denture, the patients were followed up over time, through the determination of periodic returns for control and maintenance of the prostheses, and all the information collected in these consultations was recorded in the clinical record of each patient. Controls for the evaluation of complications took place at predetermined times, which were: 2, 6, 12, 24, 36 and 41 months after the installation of the prostheses.

Complications were classified into 9 categories: ulceration, loss of retention, fracture or caries in rest seat, fracture or displacement of artificial teeth, fracture of the major connector, fracture of the clasp, fracture of the rest, inefficient support (denture relining), and fracture of the denture. Each category was subdivided into “presence” or “absence” of complications.

An independent professional, different from the one who performed the prosthetic rehabilitation, performed the data collection with the objective of making the patient comfortable and to report any type of intercurrence in the follow-up sessions. Repairs were made if any complications were observed. The complexity of each failure was evaluated according to its influence on treatment prognosis and repairability. New prostheses were manufactured in cases of serious failure. Repairable cases were kept in the original sample, while cases that required the fabrication of new prostheses were excluded from the next follow-up.

Statistical analysis

Variables were described as numbers and proportions of frequency and type of complications, from the 2-month follow-up after mandibular PPR insertion.

III. RESULTS

Initially, 70 patients were included in the study. After loss of data of 5 individuals, the sample was composed by 65 patients wearing mandibular Kennedy Class I RPD and maxillary CD (mean age of 53.9 years, comprised of 8 men-12.3%, and 57 women-87.7%).

Table 1 shows data about the occurrence and distribution of complications within the failure criteria during 39 months.

At the 2-month follow-up, ulceration was the only complication observed among 53 patients (5.66%). No complications were found in the remaining sample.

In the evaluation after 6 and 12 months, RPD complications were loss of retention (n=2), inefficient support (n=1), and severe fracture of the denture (n=1). The highest failure rate was observed after 2 and 3 years of denture insertion (Table 1). After the 2-year follow-up, loss of RPD retention was the most common prosthetic complication reported. However, this failure is not catastrophic as composite resin can be added to restore the retentive area. In general, 19 complications were reported, including ulceration (31.57%) and loss of retention (31.57%) as the most representative failure patterns.

Actuarial method was used to calculate cumulative survival, which represents denture reliability without occurrence of complications (Fig. 1).

The cumulative survival should be represented in percentage (i.e., 1.0 means 100% of cumulative survival). The length of time of RPD wearing was shown in periods: period 0 (baseline), 1–12-month follow-up, 2–24 month

follow-up, 3–36 month follow-up, and 4 – to more than 36 months. The cumulative survival was 66% at the end of the analysis (period 4). This data does not represent the number of patients wearing dentures, but that the probability of denture wearing without complications during this period was over 60% within the conditions of this study.

A total of 5 patients were excluded from the study and stopped wearing the RPD because of abutment fracture and denture loss. No patient stopped wearing RPD due to problems with adaptation to the treatment.

Table 1. Distribution of occurrence and type of complications with mandibular Kennedy Class I removable partial denture of each patient (n=65) during 39 months of follow-up. Absolut values (n).

	Time length between denture insertion and follow-up				
RPD complications	**2 months (53 patients)**	**From 6 to 12 months (48 patients)**	**From 13 to 24 months (65 patients)**	**25 months and over (65 patients)**	**Total of complications for each type**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Ulceration	3 (5.66%)	3 (6.25%)	0 (0%)	0 (0%)	6 (31.57%)
Loss of retention	0 (0%)	0 (0%)	2 (3.07%)	4 (6.15%)	6 (31.57%)
Fracture or caries in rest seat	0 (0%)	1 (2.08%)	0 (0%)	0 (0%)	1 (5.3%)
Fracture or displacement of artificial teeth	0 (0%)	0 (0%)	0 (0%)	2 (3.07%)	2 (10.5%)
Fracture of major connector	0 (0%)	0 (0%)	0 (0%)	1 (1.53%)	1 (5.3%)
Fracture of clasp (retention or opposition)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Fracture of rest	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Inefficient support	0 (0%)	1 (2.08%)	1 (1.53%)	0 (0%)	2 (10.5%)
Fracture of denture	0 (0%)	0 (0%)	1 (1.53%)	0 (0%)	1 (5.3%)
Total	**3 (5.66%)**	**5 (10.41%)**	**4 (6.13%)**	**7 (10.75%)**	**19 (100%)**

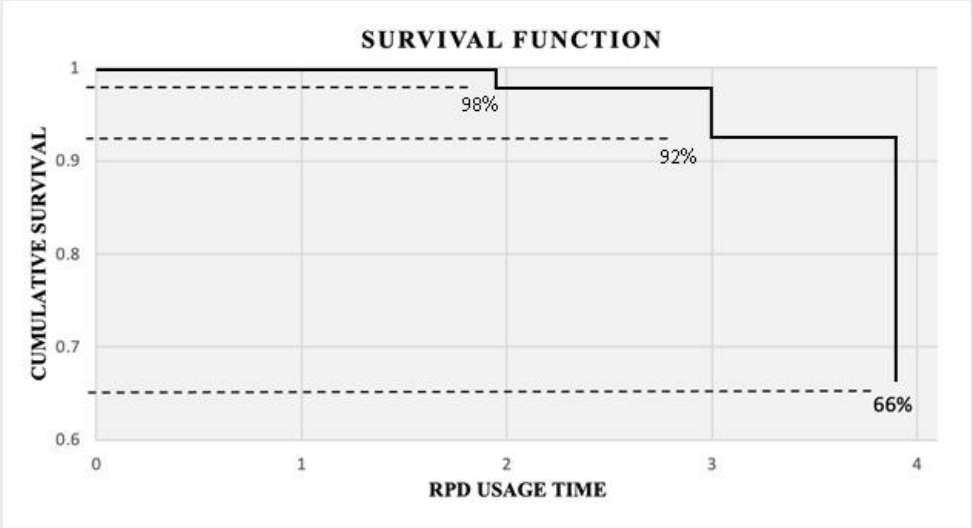

Fig.1. Cumulative survival, denture reliability without occurrence of complications (actuarial method).

IV. DISCUSSION

Despite the functional limitations inherent to a dentomucosal-supported mandibular removable prosthesis, in the present study, treatment with Kennedy class I free-end RPD had a low failure rate after 39 months of periodic follow-ups. Therefore, it is advantageous, especially when a minimally invasive and low-cost treatment is required.

Knowing that mandibular tooth-mucosal prostheses are more technically sensitive, we justify the good performance of the prostheses accompanied in this study by the rigor in the fulfillment of all clinical steps, from the initial planning, preparation of the abutment elements, functional molding, clinical tests, and the follow-up after installation. The laboratory steps were also strictly followed and as a differential, we highlight the reassembly in an articulator for occlusal adjustment after acrylization.[20]

Among the complications found, loss of retention and the presence of ulcers were the most common. Traumatic ulcers are characterized by ulcerations, usually of small dimensions, well delimited, surrounded by an erythematous halo, without elevations of the margins and with a whitish color.[21,22] The lack of integrity of the fibromucosa at the first moment after the installation of new prostheses is relatively common, due to the initial period of adaptation of the patients. However, after the initial stage of the adaptation has passed, the patient's oral conditions, regarding the appearance of areas of redness or lesions, should become stable, no longer bothering the patient, with greater comfort over time. The presence of traumatic ulcers is associated after the initial period of adaptation to the biomechanical characteristics related to the partial free extremity denture, due to the difference in resilience between the periodontal ligament of the abutment teeth and the fibromucosa.[1]

In the present study, there was a low percentage of occurrence of ulcers after the initial adaptation period (2nd month of prosthesis use). Among the clinical steps, we believe that the functional impression played a fundamental role, as it aims to extend the prosthesis within the limits of the patchable area and allow intimate contact between the base of the prosthesis and the fibromucosa.[23] It is also important to assess the need to reline in the control sessions, since the installation of a free-end prosthesis increases the tendency for an imbalance in the ridge resorption process due to the power arm, represented by the prosthesis base, being in most cases, larger than the resistance arm, represented by the segment of teeth remaining in the arch. Thus, no matter how stable the prosthesis is, there will always be greater compression at the distal end and thus resorption occurs in an increasing way from the mesial to the distal.[24] In these cases, relining the PPR may be indicated, as observed in two patients, with 3 and 4 years, respectively, of using the prosthesis.

Another factor that negatively influences the use of the prosthesis is the loss of retention, which can discourage the use of the prosthesis, as well as to make it not correctly perform the functions assigned to it as a rehabilitative treatment option. To fabricate the dentures for the patients in this research, in the design stage, the retention clips were properly planned in appropriate retentive areas, and in the absence, they were made in composite resin in the mouth preparation stage. However, there may be other factors potentially related to this type of failure, such as the lever movement at the free end and the possibility of deformation of the retaining clip, as well as wear of the retaining area over time.[24] Thus, we justify the

loss of retention observed only after the 13th month of prosthesis installation.

Regarding the integrity of the abutment teeth, during the follow-up period of the present study, the occurrence of caries under the previously prepared niche was not recorded and the niche fracture was observed only in one abutment element. Although abutment teeth are more susceptible to caries and periodontal problems than other teeth due to the fact that the components of the PPR structure around them facilitate the accumulation of dental biofilm,[25] we believe that oral hygiene guidelines and periodic controls after installation acted preventively. These data emphasize the importance of periodic check-ups for the longevity of the prosthesis and preservation of biological support elements.[27]

Regarding the integrity of the prosthesis, the detachment of artificial teeth from the PPR occurred infrequently. This type of failure is related, among other factors, to laboratory procedures for fabrication of the prosthesis as well as the type of artificial tooth used, regardless of the type of prosthesis.[27] According to Koyama et al. (2010)[28] in addition to planning the prosthesis, the quality of the material is also a factor that will have an impact on the prognosis of the treatment. Thus, the quality of artificial teeth is another factor that interferes in this type of technical failure. Adequate control of the occlusion should also be considered in this case, as it will avoid the occurrence of excessive forces on isolated teeth, as well as provide better direction of the forces generated during masticatory efforts.

Fracture of the metallic structure was also infrequent, with only one case of fracture of the greater connection being recorded, as observed in the study by Saito et al. (2002).[27] We emphasize the importance of respecting the steps of fabricating the metallic structure, from the design characteristics to the methods of making, finishing and polishing.[29] Lewis (1978)[30] examined 45 fractures in connectors larger than 41 PPRs that had been damaged. In 13 sites, failures were related to low fatigue strength, indicating possible problems during laboratory fabrication, which did not occur in the present study. In addition, the fracture of the prosthesis can also be related to the incorrect handling of the prosthesis by the patient themselves.

The collected data were analyzed considering a sample of 65 patients. It is considered this is a reasonably relevant sample, considering the fact that the group is quite homogeneous regarding the conditions of edentulism and rehabilitation treatment, including the antagonist arch target of the investigation. One of the limitations of this study is related to the respondent's memory bias, in this case the patients. Because of this, it was not possible to accurately determine the period in which the complication occurred.

The results may vary in the general population that uses removable partial dentures and to increase the generalizability of the results of this study, more research in different centers and with a greater number of cases is necessary. However, the relevance of the present research is highlighted in view of the absence of prospective studies that assess the complications of prosthetic treatment with this type of patient and with a similar sample.

The removable partial denture is a treatment alternative widely indicated for the rehabilitation of partially edentulous patients, since the literature has suggested it as a safe, versatile, conservative, reversible and relatively low-cost option.[31-33] However, it is important to consider that the biomechanical behavior, the success or failure of this treatment will also depend on the quality of the planning and construction of the metallic structure and the prosthesis as a whole.[33]

Despite the limitations of free-end mandibular PPR, it was observed that even after almost 4 years after its installation, patients continue to use the prostheses and the occurrence of prosthetic complications was relatively low, with an accumulated survival of 66% after more than 36 months of use of the prosthesis. The probability of not having any complications during this period was considered high. Periodic return of patients for control and maintenance of prostheses can be considered a great alternative to prevent the existence of such complications.

V. CONCLUSION

Treatment with mandibular free-end removable partial dentures showed low failure rate after 39-months of periodical follow-up.

REFERENCES

[1] Freitas RF. Mandibular implant-supported removable partial denture with distal extension: a systematic review. J Oral Rehabil 2012;39:791-798.

[2] Cunha LDP, Pellizzer EP, Verri FR, Pereira JA. Evaluation of the influence of location of osseointegrated implants associated with mandibular removable partial dentures. Implant Dent 2008;17:278-87.

[3] Shala KS, Dula LJ, Pustina-Krasniqi T, Bicaj T, Ahmedi EF, Lila-Krasniqi Z, Tmava-Dragusha A. Patient's satisfaction with removable partial dentures: A retrospective case series. Open Dent J 2016;10:656-663.

[4] Knezović Zlatarić D, Čelebić A, Valentić-Peruzović M. The effect of removable partial dentures on periodontal health of abutment and non-abutment teeth. J Periodontol 2002;73:137-44.

[5] Vermeulen A, Keltjens H, Van't Hof M, Kayser A. Ten-year evaluation of removable partial dentures: Survival rates based on retreatment, not wearing and replacement. J Prosthet Dent 1996;76:267-72.
[6] Wagner B, Kern M. Clinical evaluation of removable partial dentures 10 years after insertion: Success rates, hygienic problems, and technical failures. Clin Oral Investig 2000;4:74-80.
[7] Armellini DB, Heydecke G, Witter DJ, Creugers NH. Effect of removable partial dentures on oral health-related quality of life in subjects with shortened dental arches: A 2-center cross-sectional study. Int J Prosthodont 2008;21:524-30.
[8] Bilhan H, Erdogan O, Ergin S, Celik M, Ates G, Geckili O. Complication rates and patient satisfaction with removable dentures. J Adv Prosthodont 2012;4:109-15.
[9] Threeburuth W, Aunmeungtong W, Khongkhunthian P. Comparison of immediate-load mini dental implants and conventional-size dental implants to retain mandibular Kennedy class I removable partial dentures: A randomized clinical trial. Clin Implant Dent Relat Res 2018;20:785-792.
[10] Arinzeh TL, Tran T, Mcalary J, Daculsi G. A comparative study of biphasic calcium phosphate ceramics for human mesenchymal stem-cell-induced bone formation. Biomaterials 2005;26:3631-8.
[11] Finkemeier CG. Bone-grafting and bone-graft substitutes. Bone Joint J 2016;98-B:6-9.
[12] Gjerde C, Mustafa K, Hellem S, Rojewski M, Gjengedal H, Yassin MA, et al. Cell therapy induced regeneration of severely atrophied mandibular bone in a clinical trial. Stem Cell Res Ther 2018;9:213.
[13] Malard O, Espitalier F, Bordure P, Daculsi G, Weiss P, Corre P. Biomaterials for tissue reconstruction and bone substitution of the ear, nose and throat, face and neck. Expert Ver Med Devices 2007;4:729-39.
[14] Alqutaibi AY. A within-subject comparison of the conventional clasp-retained with attachment-retained removable partial dentures. J Taibah Univ Med Sci 2020;15:305-311.
[15] Vanzeveren C, D´Hoore W, Bercy P, Leloup G. Treatment with removable partial dentures: a longitudinal study. Part I. J Oral Rehabil 2003;30:447-58.
[16] Aljabri MK, Ibrahim TO, Sharka RM. Removable partial dentures: Patient satisfaction and complainsts in Makkah City, KSA. J Taibah Univ Med Sci 2017;12:561-564.
[17] Frank RP, Brudvik JS, Leroux B, Milgrom P, Hawkins N. Relationship between the standards of removable partial denture construction, clinical acceptability, and patient satisfaction. J Prosthet Dent 2000;83:521-7.
[18] Yeung ALP, Lo ECM, Clark RKF, Chow TW. Usage and status of cobaltchromium removal partial dentures 5–6 years after placement. J Oral Rehabil 2002;29:127-32.
[19] Anaesth SJ. The STROBE guidelines. Saudi J Anaesth 2019;13:S31-S34.
[20] Carr AB, Mcgivney GP, Brown DT. McCracken's Removable partial prosthodontics. 11th ed. St Louis; Missouri: Elsevier Mosby; 2005.
[21] Miller EL. Types of inflammation caused by oral prosthesis. J Prosthet Dent 1973;30:380-4.
[22] Budtz-Jorgensen E. Oral mucosal lesions associated with the wearing of removable dentures. J Oral Pathol 1981;10:65-80.
[23] Comparison of two functional impression techniques for distal-extension removable partial dentures. J Prosthet Dent 1988;60:470-3.
[24] Rodrigues JE, de Sousa V, Passanezi R, Pimentel F. Effects of partial removable denture with rigid connectors on inferior alveolar ridge. Rev Assoc Paul Cir Dent 1979;33:200-6.
[25] Do Amaral BA, Barreto AO, Seabra GO, Roncalli AG, da Fonte Porto Carreiro A, de Almeida EO. A clinical follow-up study of the periodontal conditions of RPD abutment and non-abutment teeth. J Oral Rehabil 2010;37:545-52.
[26] Frank RP, Brudvik JS, Leroux B, Milgrom P, Hawkins N. Relationship between the standards of removable partial denture construction, clinical acceptability, and patient satisfaction. J Prosthet Dent 2000;83:521-527.
[27] Saito M, Notani K, Miura Y, Kawasaki T. Complications and failures in removable partial dentures: a clinical evaluations. J Oral Rehabil 2002;29:627-33.
[28] Koyama S, Sasaki K, Yokoyama M, Sasaki T, Hanawa S. Evaluation of factors affecting the continuing use and patient satisfaction with removable partial dentures over 5 years. J Prosthodont Res 2010;54:97-101.
[29] Eerikäinen E, Rantanen T. Inaccuracies and defects in frameworks for removable partial dentures. J Oral Rehabil 1986;13:347-53.
[30] Lewis A. Failure of removable partial denture castings during servisse. J Prosthet Dent 1978;39:147-149.
[31] Bergman B, Hugoson A, Olsson CO. A 25 year longitudinal study of patients treated with removable partial dentures. J Oral Rehabil 1995;22:595-599.
[32] Wöstmann B, Budtz-Jorgensen E, Jepson N, Mushimoto E, Palmqvist S, Sofou A, et al. Indications for removable partial dentures: a literature review. Int J Prosthodont 2005;18:139-45.
[33] de Aquino ARL, Barreto AO, de Aquino LMM, Ferreira AMF, da Fonte Porto Carreiro A. Longitudinal Clinical Evaluation of Undercut Areas and Rest Seats of Abutment Teeth in Removable Partial Denture Treatment. J Prosthodont 2011;20:639–642.